

CLAIM

5 1. An apparatus for pumping fluid comprising:

at least one housing, said at least one housing having an exterior surface and an interior surface, said interior surface defining a chamber for receiving a plunger and having a fluid input opening and a fluid discharge opening extending between said 10 interior and exterior surfaces, said chamber having a cylindrical shape with a first end wall and a plunger opening for receiving a plunger; wherein said exterior surface of said at least one housing has a transducer surface between said first end wall and said second end wall, said interior surface and exterior surface define a first thickness and a second thickness, said transducer surface having said second thickness exhibiting 15 measurable deformation upon said chamber holding a fluid under pressure such that said transducer surface having a first position at which the chamber is at low pressure and a second position at which said chamber is at high pressure;

20 a plunger received in said plunger opening for reciprocating movement in said chamber said reciprocating movement causing fluid movement to enter said chamber through said fluid input opening and out through said fluid discharge opening; and,

25 at least one strain sensor affixed to said transducer surface, said strain sensor producing at least one signal upon said transducer surface assuming said first position and at least one signal upon said transducer surface assuming said second position to function as a integrated pressure transducer.

30 2. The apparatus of claim 1 wherein said at least one housing transducer surface is a flat surface capable of deformation upon pressurization of said chamber.

3. The apparatus of claim 1 wherein said housing has a composition selected from the metals and metal alloys consisting of titanium, aluminum, and vanadium.

4. The apparatus of claim 1 wherein said metal and metal alloy is titanium, aluminum and vanadium alloy 6Al4V.
5. The apparatus of claim 1 wherein said exterior surface of said housing has a cylindrical portion and a half cylindrical portion, said cylindrical portion forming a base for attachment to other apparatus, said half cylindrical portion having a flat planar surface and a half cylindrical surface.
6. The apparatus of claim 5 wherein said transducer surface is a bottom surface of a cavity in said flat planar surface.
7. The apparatus of claim 6 wherein said second thickness is approximately 0.10 to 0.001 inches.
- 15 8. The apparatus of claim 7 wherein said second thickness is approximately 0.05 to 0.005 inches.
9. The apparatus of claim 8 wherein said second thickness is 0.040 to 0.01 inches.
- 20 10. A method of measuring pressure in a pump chamber comprising the steps of providing at least one housing, said at least one housing having an exterior surface and an interior surface, said interior surface defining a chamber for receiving a plunger and having a fluid input opening and a fluid discharge opening extending between said 25 interior and exterior surfaces, said chamber having a cylindrical shape with a first end wall and a plunger opening for receiving a plunger; wherein said exterior surface of said at least one housing has a transducer surface between said first end wall and said second end wall, said interior surface and exterior surface define a first thickness and a second thickness, said transducer surface having said second thickness exhibiting measurable deformation upon said chamber holding a fluid under pressure such that said transducer surface having a first position at which the chamber is at low pressure 30 and a second position at which said chamber is at high pressure;

a plunger received in said plunger opening for reciprocating movement in said chamber said reciprocating movement causing fluid movement to enter said chamber through said fluid input opening and out through said fluid discharge opening; and at least one strain sensor affixed to said transducer surface, said strain sensor
5 producing at least one signal upon said transducer surface assuming said first position and at least one signal upon said transducer surface assuming said second position to function as a integrated pressure transducer;

and taking readings of the strain gauge as an indication of pressure in said chamber.